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Impact of tillage practices on soil water conservation in cotton under rainfed condition

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ABSTRACT

Tillage is the mechanical manipulations of soil to keep it lose for plant growth and free from weed during the growth of plant. The fundamental purposes of tillage include: preparing suitable seed bed for plant growth, destroying competitive weed and, improving the physical condition of soil. In order to study the impact of tillage practices on soil water conservation in cotton under rainfed condition in terms of moisture status of soil, runoff depth, soil loss, nutrient loss of six tillage practices were studied viz. Conservation tillage (1 blade harrow before sowing) (T_1), Conservation tillage (1 Tyne + 1 blade harrow) (T_2), Sub- surface tillage (90 cm H.I + 2 Tyne + blade harrow) (T_3). Economical sub-surface tillage (1 sub surface + 1 tyne + 1 blade harrow) (T_4), 1 Ploughing + 2 Tyne + 1 blade harrow (T_5), Across the slope cultivation with opening of BBF after two row + 2 tyne + 1 blade harrow (T_6). T_3 was more prominent and favorably influenced the soil moisture status due to drastic reduction in runoff, soil loss. It can be summarized that sub surface tillage is one of the easily adaptable *in-situ* soil and water conservation practice for the management of uncertain pattern of rainfall in rainfed areas.

1. Introduction

Soil and water are of our most precious natural resources. Proper soil management is a key to sustainable agricultural production. Soil management

involves six essential practices: proper amount and type of tillage, maintenance of soil organic matter, maintenance of a proper nutrient supply for plants, avoidance of soil contamination, maintenance of the correct soil acidity, and control of soil loss (erosion). All of these practices depend on soil type, soil texture, and slope as well as on the crops that are grown.

The potential for erosion of a specific soil type largely depends on the severity of the slope, the crops grown, and the number and types of tillage operations. Several techniques are available to reduce soil erosion, including residue management, crop rotation, contour tillage, grass waterways, terraces, and conservation structures. The techniques adopted must ensure the long-term productivity of the land, be environmentally sound, and, of course, be profitable.

Soil management practices are tailored to store and conserve as much as rainfall as possible by reducing runoff and increasing the storage capacity of the soil profile. A reduction in huge runoff losses from the land area will automatically mean that more water will become available for retention as soil moisture and minimize soil erosion. Soil moisture conservation practices have favorable effect on surface soil moisture conditions and consequently on the crop growth. For commercial lack host plants, which are generally grown under rain fed condition, the importance of soil moisture conservation remains high especially during its establishment stage.

Indian agriculture mostly depends upon the monsoon rains receiving during June to September. Water is crucial input for augmenting agricultural production towards sustainability. Water is most limiting natural source in arid and semiarid region. In most of the areas water available is rain water. The sustainability in the productivity of rainfed agriculture in India is frequently threatened by capricus

monsoon creating vargaries in rainfall climatology. The hazard of monsoon vagaries frequently produces extreme weather regimes registering the negative impacts on farm productivity and adversely affects the farmer economy.

2. Materials and methods

This experiment was conducted at the watershed located at Central Research Station (CRS) of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Akola is located between 19^0 51', 21 ^{0}16' N latitude, 56 ^{0} 38 and 77^0 44' E longitude and an altitude of 307.41 m above MSL. The slope of watershed is approximately 5% and having average slope of 1.6%. Soil type contributing to the field is clay, sandy, sandy loam and pasture land. The region experiences sub-humid to humid conditions in monsoon season, semi-arid in winter season and arid in summer season. Rains are mostly received from South-West monsoon during June to October with mean annual precipitation of 750 mm.

The experimental design is randomized block design (RBD). The field plot of size 47 x 24.6 m was selected for experimental studies .The field plot was divided into six equal plots, each plot representing a single treatment. This single treatment was again divided into four plots of equal size (5.4x7m) with distance of 1m between, and each plot representing a single replication. Likewise we have six treatments with each treatment having four replications. Cotton crop was cultivated during experimental period

Table 1.Treatment details

Sr.no	Treatment	Description of treatment	Size (m x m)	Area (ha)
1	T_1	Conservation tillage (1 blade harrow before	5.4x7	0.0037

		sowing)		
2	T_2	Conservation tillage (1 tyne+1 bladeharrow)	5.4x7	0.0037
3	T_3	Sub- surface tillage (90 cm H.I+2 tyne+ blade harrow)	5.4x7	0.0037
4	T_4	Economical sub-surface tillage (1 sub surface +1 tyne+1 blade harrow)	5.4x7	0.0037
5	T_5	1 ploughing+ 2 tyne +1 blade harrow	5.4x7	0.0037
6	T_6	Across the slope cultivation with opening of BBF after two row+2 tyne+1 blade harrow	5.4x7	0.0037

Rainfall at the experimental site was monitored using the recording type rain gauge. Runoff anf soil loss were monitored from plots of 0.008x0.008 ha by using float type stage level recorder was installed at the outlet of each gauging site. The runoff from each plot concentrated at the outlet of runoff plot was measured by H-flume of 0.30 m depth installed as a runoff measuring device. One of the important objectives of present investigation is to analyze treatment wise soil moisture enhancement in experimental field. Observations were taken with minimum 3 to 4 samples at various depths such as 15cm, 30cm, 45cm and 60cm depth at different growing stages of Cotton after 30 days interval from the date of sowing. The percentage moisture was calculated on oven dry basis.

3. Results and discussion

Average runoff producing rainfall obtained during experimental period was 584.9 mm in the year 2015.

Table 2.Runoff and soil loss under different tillage practices

Rainfall (mm)	Runoff (mm)						Soil loss					
	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6
90	2.87	2.75	-	-	0.24	-	3.227	2.967	-	-	1.636	-

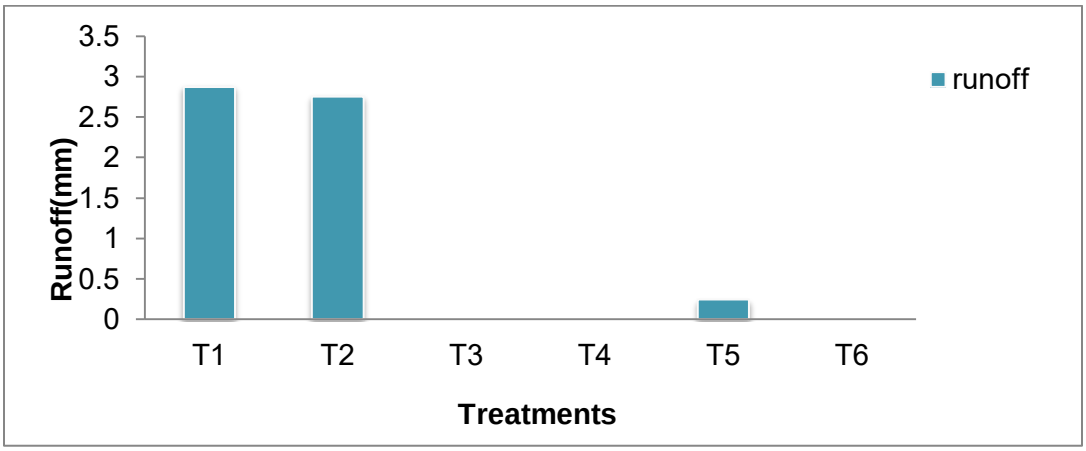

Fig .1. Impact of tillage practices on runoff

Fig.1.show the impact of tillage practices on surface runoff (mm). It revealed that there was no runoff in treatment T_3, T_4, T_6 while treatment T_2, T_5 showed the low runoff (0.12mm), (2.63mm) respectively than the treatment T_1 (2.87mm). It was also clear that in all the storms recorded no runoff due to low rainfall followed by Sub- surface tillage, Economical sub-surface tillage across the slope cultivation with opening of BBF. Thus there was a decreasing trend of surface runoff from treatment T_1 to T_4 and increase in T5 compared to T_1, T_2 it was less. In treatment T_2, T_5 there was 4.08, 91.53 per cent reduction in surface runoff over T_1, while there was 100 per cent reduction was achieved in treatment T_3, T_4,T_6 over the treatment T_1.(Table 2) shows the soil loss estimated for the treatments during the runoff event. It reveals that there was maximum soil loss (3.227 t ha^{-1}) in treatment T_1, whereas the treatment T_2 showed less soil loss compared to T_1, T_5. No soil loss was observed in treatment T_3, T_4, T_6. A prominent reduction in soil loss was due to the fact that under the system of Sub- surface tillage, Economical sub-surface tillage across the slope cultivation with opening of BBF in this

treatments velocity of flowing water was reduced by obstruction and soil particles could get longer period to settle on the ground surface. The above discussion related to surface runoff and soil loss reflects the superiority of Sub- surface tillage, Economical sub-surface tillage across the slope cultivation with opening of BBF method of *in-situ* soil and water conservation measure.

Table.3 Trend of moisture fluctuations

Treatment	At sowing	30 DAS	60DAS	90DAS	120DAS	At harvest
T_1	14.67	14.38	14.22	13.35	13.01	12.86
T_2	15.19	15.09	14.63	13.97	13.56	13.06
T_3	16.91	17.18	16.75	16.2	15.38	13.91
T_4	16.51	16.41	16.22	15.25	14.73	13.59
T_5	15.6	15.57	15.01	14.48	13.95	13.21
T_6	16.07	16.03	15.58	14.85	14.46	13.4
F-test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CD	0.38	0.34	0.64	0.36	0.61	0.1
S.E	0.12	0.114	0.213	0.12	0.20	0.035

Table.3 shows the average moisture fluctuations from the sowing stage to the harvesting stage. From the data it is revealed that there was enhancement in soil moisture content and the treatment T_3 is superior to the treatment T_4, T_5, T_6, T_2 and treatment T_1 from the sowing stage to the harvesting stage.

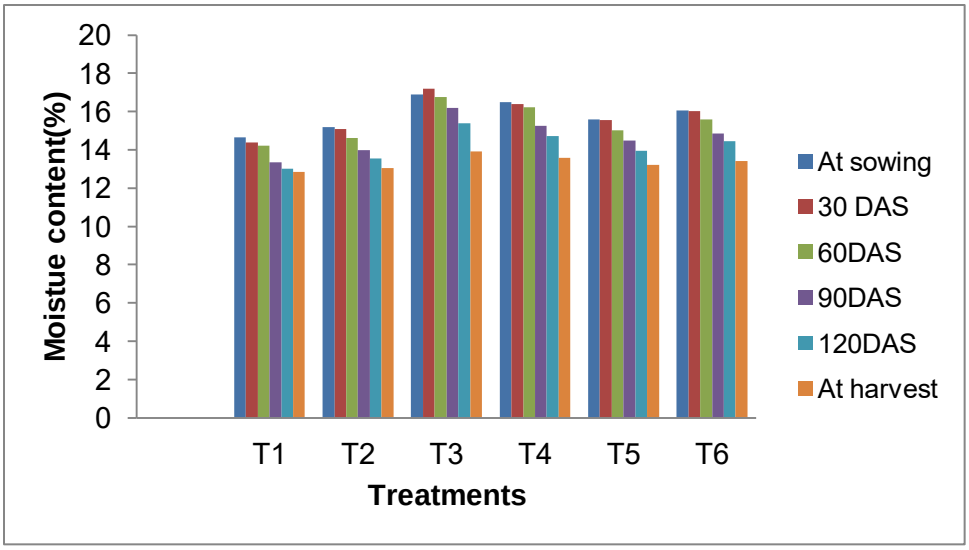

Fig.2 trend of moisture content fluctuation

Table 3 and Fig. 2 reveal that there was decrease in moisture content as commencement in duration of the crop. Further decrease in moisture content was seen from the stage of sowing to the stage of harvesting. It was observed maximum at the stage of sowing than the other stages.

4. Conclusions

From the present study it is concluded that the tillage practices has avery good effect in controlling runoff, soil loss .Sub- surface tillage (90 cm H.I+2 Tyne+ blade harrow) (T_3) was more effective than Economical sub-surface tillage (1 sub surface +1 tyne+1 blade harrow) (T_4), 1 Ploughing+ 2 Tyne +1 blade harrow (T_5), Across the slope cultivation with opening of BBF after two row + 2 tyne+1 blade harrow (T_6), Conservation tillage (1 Tyne+1 blade harrow) (T_2) over treatment Conservation tillage (1 blade harrow before sowing) (T_1) in reducing runoff, soil loss. There was enhancement in soil moisture content and the treatment T_3 is superior to the treatment T_4, T_5, T_6, T_2 and treatment T_1 from the sowing stage to the harvesting stage.

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